UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 155
Seattle, WA 98101-3123

ENFORCEMENT &
COMPLIANCE ASSURANCE
DIVISION

MAY 15 2019

Reply to: 20-C04

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Honorable Chairman Raymond Tsumpti, Jr.
Confederated Tribes of Warm Springs
P.O. Box C
1233 Veteran's Street
Warm Springs, Oregon 97761-3001

Re: Solicitation of Interest for Government-to-Government Consultation on Orders to Address Significant Deficiencies and Imminent and Substantial Endangerment to Persons Served by the Warm Springs Public Water System (PWS ID# 104101247)

Dear Chairman Tsumpti:

This letter is to inform you that the U.S. Environmental Protection Agency (EPA), Region 10 has determined that conditions exist at the Warm Springs Public Water System ("System") on the Warm Springs Reservation that may present an imminent and substantial endangerment to the health of persons served by the System. The EPA made this determination, in part, due to: 1) a pattern of turbidity exceedances that required the Warm Springs Tribes ("Tribe") to issue two boil water notices in April of 2019; 2) multiple water main breaks, two of which have caused low pressure events that required the Tribe to issue a boil water notice in November of 2018 and most recently on May 15, 2019; 3) the failure of the Tribe to maintain adequate disinfectant levels in the System's distribution for multiple days in April of 2019; and, 4) a general state of disrepair highlighted by the failure of the Tribe to address significant deficiencies within 45 days of those deficiencies being identified and re-identified in sanitary surveys performed in 2015 and 2018, respectively. These conditions substantially increase the risk that the System's drinking water may contain disease-causing organisms, such as cryptosporidium, giardia and *E. coli* that may endanger the health of people drinking that water, especially vulnerable populations such as pregnant women, young children and elders.

The EPA will issue an Emergency Administrative Order ("Emergency Order") to the Tribe, pursuant to Section 1431 of the Safe Drinking Water Act, 42 U.S.C. § 300i, no later than May 23, 2019. In the Emergency Order, EPA will require the Tribe to take specific actions that will ensure the protection of human health. The EPA is also proposing a separate consent order to address significant deficiencies. The two orders, which carry separate tribal consultation timelines, are described in detail below.

<u>Emergency Order</u>
The EPA would like to provide the Tribe with the opportunity to consult with EPA on the Emergency Order in accordance with the "Enforcement Response Policy under the Safe Drinking Water Act" and EPA "Guidance on the Enforcement Principles Outlined in the 1984 Indian Policy," which implements EPA's "Policy on Consultation and Coordination with Indian Tribes." **Due to the nature of the public**

health threat addressed by the Emergency Order, such consultation must be expedited. For this reason, consultation must occur on or before May 22, 2019, if the Tribe wants to consult with EPA prior to the issuance of this Order. The EPA believes this expedited consultation is appropriate because of the threats to public health. If it is not feasible to consult in person or by phone prior to EPA signing the Emergency Order, EPA is also willing to meet with the Tribe at any time after issuance to discuss this Order and any information the Tribe may feel is important for EPA to consider as it relates to this matter.

Consent Order

The EPA has also enclosed a proposed Administrative Order on Consent ("Consent Order") pursuant to Section 1414 of the Safe Drinking Water Act (Act), 42 U.S.C. § 300g-3. The Consent Order provides increased compliance monitoring by EPA of the Tribe for the unaddressed significant deficiencies EPA identified in our Notice of Violation letter to the Tribe on November 27, 2018. The EPA appreciates the work the Tribe has already completed to begin addressing this list of deficiencies. However, EPA believes the remaining deficiencies should be addressed within the context of a Consent Order to emphasize the importance of that work to keep drinking water safe. The corrective actions for deficiencies that relate to the turbidity exceedances were also placed into the Emergency Order to emphasize the order of priority for those actions. The enclosed proposed Consent Order is effective when signed both by EPA and the Tribe, and compliance is achieved by meeting the required actions in the Consent Order.

The EPA would like to provide the Tribe with the opportunity to consult with EPA on the Consent Order ideally in person, should schedules allow, in accordance with the policies described above. **Consultation on the Consent Order should take place no later than June 7, 2019,** to inform a clear statement of the Tribe's needs in advance of the funding summit currently scheduled for June 12, 2019, with other federal funding partners and the State of Oregon. It is EPA's sincere hope that the Tribe, EPA and other relevant parties will work collaboratively in the decision-making process to prioritize equipment upgrades and operation and maintenance requirements with a sensitivity to the Tribe's needs and funding sources once both Orders discussed above are in effect.

Ultimately, EPA's goal is to work with you to ensure the safety of drinking water for all persons served by the System. Please contact Wenona Wilson, Senior Tribal Policy Advisor, at (206) 553-2148 or wilson.wenona@epa.gov to make consultation arrangements. If you have specific questions about the orders discussed in this letter, please contact me directly at (206) 553-6695. Thank you for your prompt attention to this important matter.

Sincerely,

Edward J. Kowalski
Director

Enclosure

cc: Mr. Raymond Moddy
Warm Springs Tribal Council

Mr. Lincoln Jay Suppah
Warm Springs Tribal Council

Mr. Delvis Heath
Warm Springs Tribal Council

Ms. Lola Sohappy
Warm Springs Tribal Council

Ms. Anita Jackson
Warm Springs Tribal Council

Mr. Glendon Smith
Warm Springs Tribal Council

Mr. Alfred Smith Sr.
Warm Springs Tribal Council

Ms. Brigette McConville
Warm Springs Tribal Council

Mr. Wilson Wewa
Warm Springs Tribal Council

Mr. Joseph Moses
Warm Springs Tribal Council

Cpt. Mathew Martinson
Indian Health Service

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10

In the Matter of:	)	
	)	
Confederated Tribes of Warm Springs,	)	
	)	
Respondent	)	Docket No. SDWA-10-2019-0078
	)	
Warm Springs Public Water System	)	
(ID# 104101247)	)	ADMINISTRATIVE COMPLIANCE
	)	ORDER ON CONSENT
Facility	)	
	)	

I. AUTHORITY

1.1. This Administrative Compliance Order ("Order") is issued pursuant to the authority vested in the Administrator of the United States Environmental Protection Agency ("EPA") by Section 1414(g) of the Safe Drinking Water Act ("SDWA"), 42 U.S.C. § 300g-3(g). The Administrator has delegated this authority to the Region 10 Regional Administrator, who in turn delegated this authority to the Director of the Enforcement and Compliance Assurance Division.

1.2. The EPA has primary enforcement responsibility for the SDWA public water supply protection program on the Warm Springs Reservation. No other governmental authority has applied for or been approved to administer the SDWA public water supply protection program on the Warm Springs Reservation.

II. FINDINGS OF FACT AND CONCLUSIONS OF LAW

2.1. The Confederated Tribes of the Warm Springs ("Respondent") owns and operates the Warm Springs Public Water System ("System"), located on the Warm Springs Reservation, that provides water for human consumption.

2.2. Respondent is a "person" within the meaning of Section 1401(12) of SDWA, 42

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U.S.C. § 300f(12), and 40 C.F.R. § 141.2, for purposes of federal enforcement under the SDWA.

2.3. Respondent's System serves approximately 3,800 persons, including 1,356 residential connections and numerous tribal facility connections serving office buildings, at least one day care, at least two schools, at least one senior center, and at least one medical center.

2.4. Respondent's System is a public water system within the meaning of Section 1401(4) of SDWA, 42 U.S.C. § 300f(4), and 40 C.F.R. § 141.2.

2.5. Respondent's System regularly serves at least 25 year-round residents and is therefore a "community water system" within the meaning of Section 1401(15) of SDWA, 42 U.S.C. § 300f(15), and 40 C.F.R. § 141.2.

2.6. Respondent owns and operates the System and therefore is a "supplier of water" within the meaning of Section 1401(5) of SDWA, 42 U.S.C. § 300f(5), and 40 C.F.R.§ 141.2. Respondent is subject to the requirements of Part B of the SDWA, 42 U.S.C. § 300g, and its implementing regulations, 40 C.F.R. Part 141.

2.7. The System is solely supplied by a surface water from the Deschutes River, which is treated with conventional filtration at the System's Dry Creek Treatment Plant.

2.8. EPA provided Respondent written notice of significant deficiencies in its System and a copy of the sanitary survey report on November 27, 2018 following EPA's sanitary survey conducted on July 18, 2018.

2.9. 40 C.F.R. § 141.723(c) requires a surface water system, within 45 days of receiving a sanitary survey report, to either correct the significant deficiencies or develop an approved corrective action plan on how and when the deficiencies will be addressed and to maintain compliance with the corrective action plan and schedule.

2.10. On December 6, 2018, Respondent provided an email to EPA which explained it was committed to resolving the significant deficiencies. This email failed to adequately explain how Respondent would address these immediate health concerns, nor did it provide the date and manner by which the

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significant deficiencies would be addressed.

2.11. On December 20, 2018, EPA sent another letter to Respondent advised Respondent that it was required to address the noticed significant deficiencies or provide a corrective action plan no later than January 12, 2019.

2.12. On March 13, 2019, EPA sent a Notice of Violation letter to Respondent that it was in violation of the 40 C.F.R. § 141.723(c) for failure to address the noticed significant deficiencies or provide a corrective action plan. The EPA also informed the Respondent that this violation was a treatment technique violation, which requires Tier 2 public notice to the System's customers within 30 days pursuant to 40 C.F.R. § 141.203(c), and EPA provided an attached public notice template to this letter.

2.13. 40 C.F.R. § 141.203 requires that certain violations be noticed to persons served by a community water system via hand or direct delivery, or mail as a separate notice or included with the bill. These notices must be provided as soon as practical, but no later than 30 days after the system learns of the violation and must be repeated every three months as long as the violation persists.

2.14. On April 9, 2019, Respondent provided an email with a draft Corrective Action Plan ("CAP") for EPA approval. The CAP contained evidence that certain, but not all, noticed significant deficiencies were corrected. The CAP also included a schedule and description of planned actions to correct the remaining significant deficiencies. The EPA has not yet approved Respondent's CAP due to both its delinquency and lack of details on planned actions.

III. VIOLATIONS

3.1. 40 C.F.R. § 141.723(c) requires a surface water system, within 45 days of receiving a sanitary survey report, to either correct the significant deficiencies or develop an approved corrective action plan on how and when the deficiencies will be addressed and to maintain compliance with the corrective action plan and schedule. EPA provided Respondent written notice of significant deficiencies on November 27, 2018 following the sanitary survey of the System conducted on July 18, 2018. Respondent failed to submit a corrective action plan or provide evidence that the remaining significant deficiencies had been addressed within 45 days. Therefore, Respondent violated this applicable requirement.

IV. ORDER

Based upon the foregoing and pursuant to Section 1414(g) of the SDWA, 42 U.S.C. § 300(g)-3(g), it is hereby ordered as follows:

4.1. Respondent shall correct the significant deficiencies as described below:

a. Within 30 days of the effective date of this Order, Respondent shall implement its Coagulation Standard Operating Procedure (Attachment A) developed for the Plant.

b. Install a gasket to hatch on top of System's Tee Wee water storage tank by June 1, 2019.

c. Install a new roof top vent with 24-mesh screen on System's Tee Wee water storage tank by June 1, 2019.

d. Install a gasket and lock to hatch on System's Kah-Ne-Ta water storage tank by June 1, 2019.

e. Install a 24-mesh on overflow pipe on System's Southeast water storage tank by June 1, 2019.

f. Install a new roof top vent with 24-mesh screen on System's Southeast water storage tank by June 1, 2019.

g. Install a gasket and lock to hatch on System's West Hills West water storage tank by June 1, 2019.

h. Install a 24-mesh on overflow pipe on System's West Hills West water storage tank by June 1, 2019.

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i. Install a ladder with safety cage to allow for adequate and safe access to System's West Hills East water storage tank by June 1, 2019.

k. Install a ladder with safety cage to allow for adequate and safe access to System's West Hills East water storage tank by June 1, 2019.

l. Install a gasket to hatch on System's Greely West water storage tank by June 1, 2019.

m. Install a 24-mesh on overflow pipe on System's Greely East water storage tank by June 1, 2019.

n. Install a ladder with safety cage to allow for adequate and safe access to System's Greely East water storage tank by June 1, 2019.

o. Service and repair and/or upgrade HVAC system in water treatment plant to provide adequate ventilation for heat and moisture dissipation from drinking water treatment equipment by June 1, 2019.

p. Complete removal of settled solids from sedimentation tank by June 1, 2019.

q. Install functioning turbidimiter sampling pump for filter #2 IFE by June 1, 2019.

r. Restore and/or upgrade river intake air scour system to provide for appropriate operation by June 1, 2019.

s. Reduce turbidimeter sampling delays by June 1, 2019.

t. Physically disconnect out-of-service concrete water storage tank from distribution system by July 1, 2019.

4.2. Within 30 days of the effective date of this Order, Respondent shall issue a Tier 2 public notice for violation listed in Paragraph 3.1 above. Respondent shall repeat this public notice every three

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months as long as the violation persists.

4.3. Respondent must provide the public notices required above by mail or other direct delivery to each customer receiving a bill and to other service connections to which water is delivered. The public notices must also be delivered to other persons regularly served by the System via any other method reasonably calculated to reach persons regularly served by the System who would not normally be reached via mail or other direct delivery. Other methods of delivery include publication in a local newspaper, posting in public places or on the Internet, or email. If a notice is posted, it must remain in place for as long as the violation persists, but in no case less than seven days, even if the violation is resolved.

4.4. Within 30 days of the effective date of this Order, and every three months thereafter, Respondent shall send EPA a copy of the public notice and a certification that the System has fully complied with the public notification regulations.

V. GENERAL PROVISIONS

5.1. For violations of this Consent Order, Respondent may be subject to a civil penalty of not more than $57,317.00 per day of violation pursuant to Section 1414(g)(3)(A) of the SDWA, 42 U.S.C. § 300g-3(g)(3)(A) as adjusted by the Federal Civil Penalties Inflation Adjustment Act of 1990, amended by the Debt Collection Improvement Act of 1996, and the subsequent Civil Monetary Penalty Inflation Adjustment Rule, 40 C.F.R. Part 19.

5.2. Nothing in this Order shall be construed to relieve Respondent of any applicable requirements of federal, state, or local law.

5.3. The EPA reserves the right to take enforcement action as authorized by law for any violation of this Order, and for any future or past violation of any applicable legal requirements of the SDWA including, but not limited to, the violations identified in Part III of this Order.

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5.4. The provisions of this Order are binding upon Respondent, and all officers, directors, agents, employees, successors, and assigns of Respondent.

5.5. This Order shall become effective on the date it is signed by EPA, after having been signed by Respondent.

5.6. Respondent waives any and all remedies, claims for relief and otherwise available rights to judicial or administrative review that Respondent may have with respect to any issue of fact or law set forth in this Order on Consent, including any right of judicial review under SDWA Section 1448.

5.7. The EPA and Respondent may agree to modify this Order on Consent. Such modification shall be in writing and shall be incorporated into this Order.

5.8. The provisions of this Order shall be deemed satisfied upon Respondent's receipt of written notice from EPA that Respondent has demonstrated, to the satisfaction of EPA, that the terms of this Order, including any additional tasks determined by EPA to be required under this Order or any continuing obligation or promises, have been satisfactorily completed.

The EPA and the Warm Springs Tribe agree to the Order above.

The Confederated Tribes of Warm Springs by and through the following Tribal Representative:

Dated this _______ day of ______________________, 2019.

____

Tribal Council Chair or delegated official signature

Please Print:

____

Name

____

Title

EPA, by and through the Enforcement and Compliance Assurance Division Director:

Dated this _____ day of ________________, 2019.

____

Edward J. Kowalski, Director

Attachment A

The Confederated Tribes of Warm Springs

CONFEDERATED TRIBES OF
WARM SPRINGS
1855

Coagulation Control

Standard Operating Procedure
Dry Creek Water Treatment Plant

Warm Springs Community Water System
EPA PWS ID# 104101247

Approvals:

Chico Holliday
Water Wastewater Supervisor
Confederated Tribes of Warm Springs

04/09/19
Date

Travis Wells
General Manager
Branch of Public Utilities
Confederated Tribes of Warm Springs

4/9/19
Date

February 2019

Coagulant Control SOP

Purpose of Coagulant Control

Nearly every process in a water treatment plant depends on proper coagulation. When coagulation is optimized, flocculation and sedimentation are better able to remove particles before they get to the filter. Coagulation also conditions particles so they can be effectively captured by the filter. Further, removing particles from the water dramatically improves the effectiveness of disinfection, to prevent pathogens getting into the distribution system.

This SOP is intended to serve as a functional, practical guide to the tasks that need to be done in order to optimize coagulant dosage. Coagulant control has two parts: the streaming current monitor (SCM) and jar testing. They perform separate but complementary roles.

The SCM indicates the overall charge of the water after coagulant addition. Since water particles are naturally negative, the positively-charged coagulant is used to reduce this negative charge as much as possible. As long as a charge remains, the particles will not be able to floc together and settle out, nor be properly removed by the filter. A negative charge read by the SCM indicates that too little coagulant is being added. A positive charge read by the SCM means that too much coagulant is added. The SCM provides a very responsive indication of the charge of the water, in reaction to changes in both water quality and coagulant dosage. An ideal SCM reading is 0.00 Streaming Current Units (SCUs).

Jar testing complements the SCM by serving as a gut check while the SCM is functioning properly, and as a back-up when the SCM is malfunctioning or broken. It is extremely important to continue jar testing weekly even when the SCM is working properly.

Operation and Maintenance of the SCM and Turbidimeters

The following tasks are necessary to perform on a regular basis to ensure the SCM is operating properly and that coagulant is being properly dosed.

Hourly

Check the SCM value and adjust the LMI pump stroke as needed to control coagulant dosage (see instructions for adjusting LMI pump dosage below)

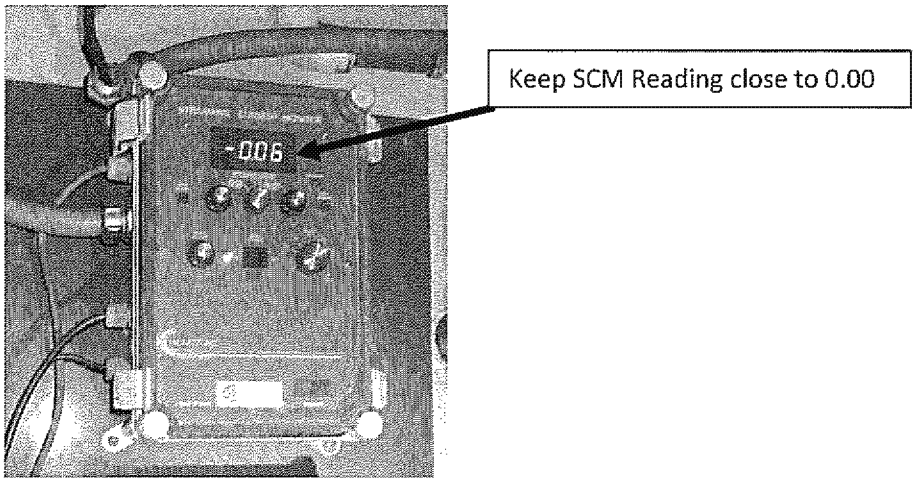

Fig 1. Streaming Current Monitor

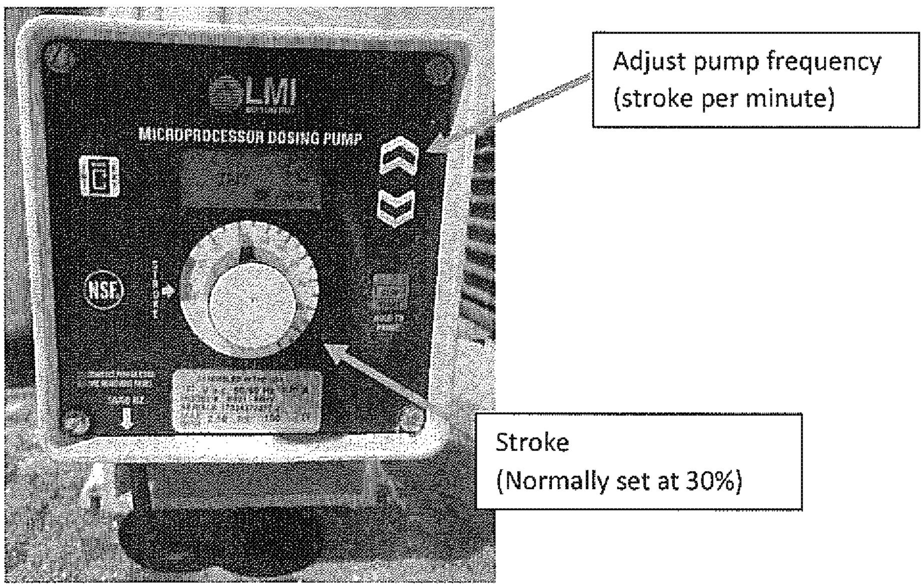

Fig 2. LMI Pump

SCM reading will respond to frequency adjustments in about 1 minute and 30 seconds. Adjust frequency again until SCM reading is close to 0.00.

Record the SCM reading before pump adjustment, adjusted LMI pump information (pump stroke and speed), SCM reading after pump adjustment, and whether one or 2 raw water pumps are in operation (sample data sheet provided at the end of this document).

Daily

Briefly flush the hydrocyclone and the sand filter to remove built up sediment. Close valve once flow is clear of sediment.

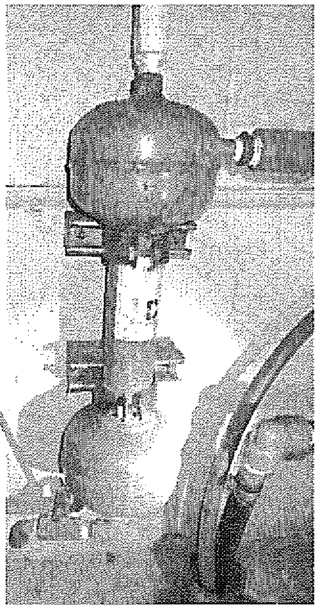

Fig 3. Hydrocyclone

Fig 4. Sand Filter

Verify water supply to the SCM probe

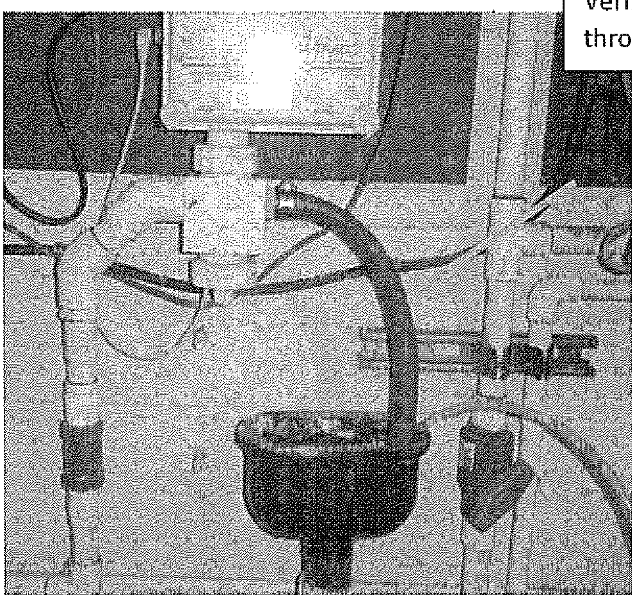

Fig 5. SCM Sample and Drain Line

Perform jar testing if the SCM is not functioning properly

Weekly

Clean the SCM probe and piston of organic slime build up using Comet Soft Scrub and bottle brushes (see instructions below)

Perform jar testing to ensure LMI pump coagulant dosage is correct, based on SCM readings

Every 3 months

Calibrate each turbidimeter (see User Manual, Hach 1720E Low Range Turbidimeter, Section 5.5)

Yearly

Replace bulbs in each turbidimeter (see User Manual, Hach 1720E Low Range Turbidimeter, Section 6.4.3)

Every few years or as needed

Replacement of the plastic tubing to and from the turbidimeters

Instructions on adjusting LMI pumping rate: (note: this section was modified from Section 8 of the Instruction Manual for the Series B9 and C9 Electronic Metering Pumps, produced by Novatech International.)

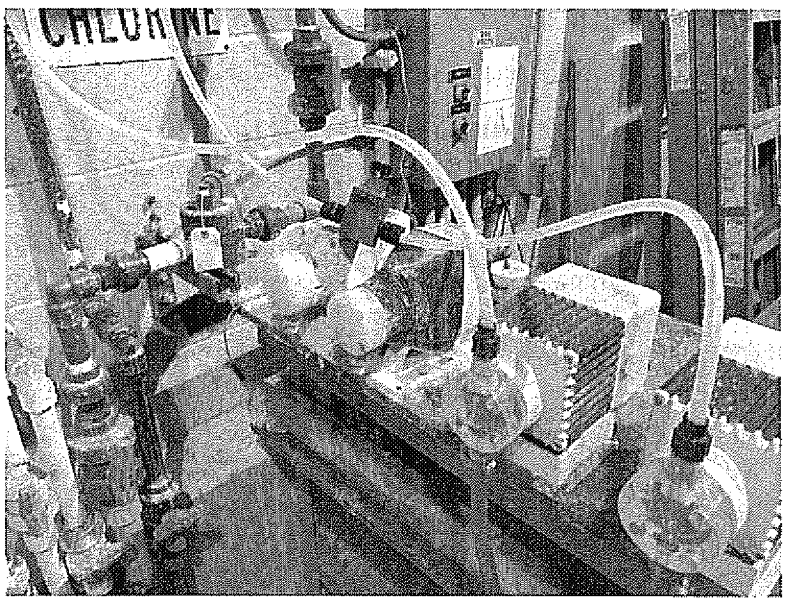

Fig 6. The chemical feed pumps. Verify which pump is supplying coagulant before making any adjustments. These pumps are located near the ACH feed barrels and the static mixer.

Fig. 7. Controls for the LMI Pump

1. Speed and stroke length can be changed while the pump is on or off.
2. To adjust the speed of the LMI pump, simply use the up or down arrows to change the speed. Ensure that the speed is displayed in numbers only. If the number for speed reads like H60, then that means the speed is in strokes per hour. To fix this, press the up arrow until the "H" disappears, so that stroke speeds are in strokes per minute. The current speed will be displayed on the liquid crystal display screen, just to the left of the arrows.
3. To adjust the stroke length of the LMI pump, simply rotate the knob until the pointer matches with the stroke length you want to set.
4. Since the SCM takes about 1.5 minutes to read flows from the initial mixer, it will take 1.5 minutes to respond to changes in coagulant dosage. Thus, just change either speed or stroke by a couple units at a time to see how the SCM responds. When fine-tuning, just change them by one unit at a time.
5. To calculate the flow rate from the LMI pump, divide the stroke number by 100, as well as the speed. Then multiply those numbers together, and multiply the result by 2.5. This will give you the flowrate from this pump in gallons per hour. For example, if speed was set to 50 and stroke

was set to 50, the actual flowrate would be: (50/100) * (50/100) = 0.25. 0.25 * 2.5 = 0.625 gallons per hour.

Instructions on cleaning the SCM Probe: (note: This section was modified from Section 5 of the Operations Manual for the SCM 2000 XRW, produced by ChemTrac Systems, Inc.)

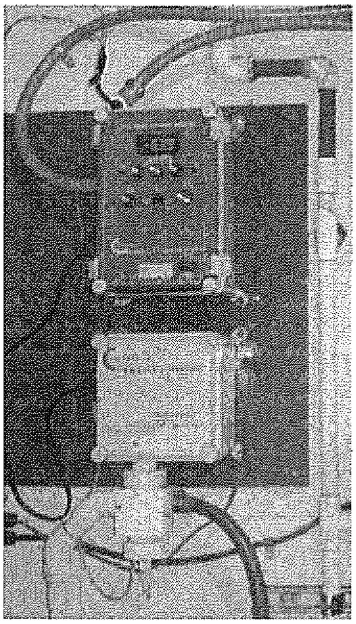

Fig. 8. ChemTrac display (top) and SCM (bottom). This is located in the same room as the raw water pumps, on the opposite wall.

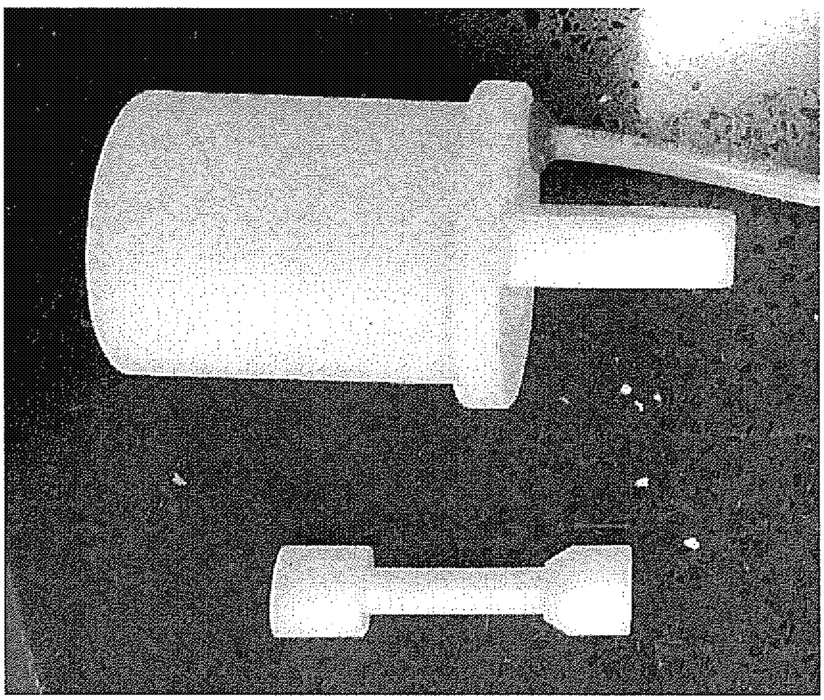

Fig. 9. Probe (top) and piston (bottom). Note the probe tab on the right side of this picture.

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1. Disconnect the lead wire from the enclosure and remove the lower retaining slip nut from the probe.
2. Remove the probe by pulling on the tab. A small twist may be needed to loosen it.
3. Remove the piston using an appropriately sized flathead screwdriver.
4. Clean any debris from the cell housing.
5. To clean the probe wet ONLY the inside of the probe. DO NOT SUBMERGE OR SOAK THE PROBE. Sprinkle some Comet on the inside and scrub with a bottle brush. Rinse thoroughly with distilled water to remove any residue.
6. To clean the piston wet the outside of the piston. Sprinkle some Comet on the outside and scrub with a bottle brush. Rinse thoroughly with distilled water to remove any residue.
7. Screw clean piston into place. Do not over-tighten. Only slight torque is necessary.
8. Insert the clean probe back into the cell housing.
9. Slip the retaining nut over the probe lead wire and tighten onto probe. Finger tight is acceptable. Take care to ensure that the nut is not cross threaded.
10. Connect lead wire to the enclosure.
11. After cleaning the probe, the SCM readings may take several minutes to stabilize. The SCM may also be more sensitive to changes in coagulant feed or raw water. After the readings stabilize, adjust the LMI pump as needed to reduce the SCM reading to 0.00 SCUs.

A rough approximation of ACH dosing by the chemical feed pump can be estimated by using the table on the next page. This can be used to select the starting point for jar testing.

		Approximate ACH Dosage in mg/L based on Stroke and Speed - 1 Pump in Operation									
		Stroke Length (from 5-50)									
		5	10	**15**	20	**25**	30	**35**	40	**45**	50
Speed (from 5-50 strokes per minute)	5	**0.06**	0.13	**0.19**	0.26	**0.32**	0.38	**0.45**	0.51	**0.58**	0.64
	10	**0.13**	0.26	**0.38**	0.51	**0.64**	0.77	**0.89**	1.02	**1.15**	1.28
	15	**0.19**	0.38	**0.58**	0.77	**0.96**	1.15	**1.34**	1.53	**1.73**	1.92
	20	**0.26**	0.51	**0.77**	1.02	**1.28**	1.53	**1.79**	2.04	**2.30**	2.56
	25	**0.32**	0.64	**0.96**	1.28	**1.60**	1.92	**2.24**	2.56	**2.88**	3.19
	30	**0.38**	0.77	**1.15**	1.53	**1.92**	2.30	**2.68**	3.07	**3.45**	3.83
	35	**0.45**	0.89	**1.34**	1.79	**2.24**	2.68	**3.13**	3.58	**4.03**	4.47
	40	**0.51**	1.02	**1.53**	2.04	**2.56**	3.07	**3.58**	4.09	**4.60**	5.11
	45	**0.58**	1.15	**1.73**	2.30	**2.88**	3.45	**4.03**	4.60	**5.18**	5.75
	50	**0.64**	1.28	**1.92**	2.56	**3.19**	3.83	**4.47**	5.11	**5.75**	6.39

		Approximate ACH Dosage in mg/L based on Stroke and Speed - 2 Pumps in Operation									
		Stroke Length (from 5-50)									
		5	10	**15**	20	**25**	30	**35**	40	**45**	50
Speed (from 5-50 strokes per minute)	5	**0.03**	0.06	**0.09**	0.12	**0.15**	0.18	**0.21**	0.24	**0.27**	0.30
	10	**0.06**	0.12	**0.18**	0.24	**0.30**	0.36	**0.42**	0.48	**0.54**	0.60
	15	**0.09**	0.18	**0.27**	0.36	**0.45**	0.54	**0.63**	0.72	**0.81**	0.90
	20	**0.12**	0.24	**0.36**	0.48	**0.60**	0.72	**0.84**	0.96	**1.08**	1.20
	25	**0.15**	0.30	**0.45**	0.60	**0.75**	0.90	**1.05**	1.20	**1.35**	1.50
	30	**0.18**	0.36	**0.54**	0.72	**0.90**	1.08	**1.26**	1.44	**1.62**	1.80
	35	**0.21**	0.42	**0.63**	0.84	**1.05**	1.26	**1.47**	1.68	**1.89**	2.10
	40	**0.24**	0.48	**0.72**	0.96	**1.20**	1.44	**1.68**	1.92	**2.16**	2.40
	45	**0.27**	0.54	**0.81**	1.08	**1.35**	1.62	**1.89**	2.16	**2.43**	2.70
	50	**0.30**	0.60	**0.90**	1.20	**1.50**	1.80	**2.10**	2.40	**2.70**	2.99

		Approximate ACH Dosage in mg/L based on Stroke and Speed - 1 Pump in Operation									
		Stroke Length (from 5-50)									
		5	10	**15**	20	**25**	30	**35**	40	**45**	50
Speed (from 55-100 strokes per minute)	55	**0.76**	1.53	**2.29**	3.06	**3.82**	4.58	**5.35**	6.11	**6.88**	7.64
	60	**0.83**	1.67	**2.50**	3.33	**4.17**	5.00	**5.83**	6.67	**7.50**	8.33
	65	**0.90**	1.81	**2.71**	3.61	**4.51**	5.42	**6.32**	7.22	**8.13**	9.03
	70	**0.97**	1.94	**2.92**	3.89	**4.86**	5.83	**6.81**	7.78	**8.75**	9.72
	75	**1.04**	2.08	**3.13**	4.17	**5.21**	6.25	**7.29**	8.33	**9.38**	10.42
	80	**1.11**	2.22	**3.33**	4.44	**5.56**	6.67	**7.78**	8.89	**10.00**	11.11
	85	**1.18**	2.36	**3.54**	4.72	**5.90**	7.08	**8.26**	9.44	**10.63**	11.81
	90	**1.25**	2.50	**3.75**	5.00	**6.25**	7.50	**8.75**	10.00	**11.25**	12.50
	95	**1.32**	2.64	**3.96**	5.28	**6.60**	7.92	**9.24**	10.56	**11.88**	13.19
	100	**1.39**	2.78	**4.17**	5.56	**6.94**	8.33	**9.72**	11.11	**12.50**	13.89

		Approximate ACH Dosage in mg/L based on Stroke and Speed - 2 Pumps in Operation									
		Stroke Length (from 5-50)									
		5	10	**15**	20	**25**	30	**35**	40	**45**	50
Speed (from 55-100 strokes per minute)	55	**0.36**	0.72	**1.07**	1.43	**1.79**	2.15	**2.51**	2.86	**3.22**	3.58
	60	**0.39**	0.78	**1.17**	1.56	**1.95**	2.34	**2.73**	3.13	**3.52**	3.91
	65	**0.42**	0.85	**1.27**	1.69	**2.12**	2.54	**2.96**	3.39	**3.81**	4.23
	70	**0.46**	0.91	**1.37**	1.82	**2.28**	2.73	**3.19**	3.65	**4.10**	4.56
	75	**0.49**	0.98	**1.46**	1.95	**2.44**	2.93	**3.42**	3.91	**4.39**	4.88
	80	**0.52**	1.04	**1.56**	2.08	**2.60**	3.13	**3.65**	4.17	**4.69**	5.21
	85	**0.55**	1.11	**1.66**	2.21	**2.77**	3.32	**3.87**	4.43	**4.98**	5.53
	90	**0.59**	1.17	**1.76**	2.34	**2.93**	3.52	**4.10**	4.69	**5.27**	5.86
	95	**0.62**	1.24	**1.86**	2.47	**3.09**	3.71	**4.33**	4.95	**5.57**	6.18
	100	**0.65**	1.30	**1.95**	2.60	**3.26**	3.91	**4.56**	5.21	**5.86**	6.51

Purpose of Jar Testing

The purpose of jar testing is to determine what dosage of coagulant works best for a given set of water conditions. In cases where the SCM isn't working, jar testing is needed once per day to find the optimal dosage of coagulant. Even when the SCM is operational, jar testing about once a week is still good practice to ensure proper dosage rates are used. Jar testing can help improve the operation of the plant dramatically, by ensuring more solids are removed through flocculation and sedimentation. This relieves some of the burden on the filters, and increases filter run time. Further, determining the right dosage of coagulant can help save money for the plant.

One round of jar testing should take less than an hour to complete. It will take less time the more often you do it. Be sure to set aside about an hour for the first round you do.

Overview of chemical and equipment needs

To conduct jar testing you will need:

- A gang stirrer
- 6 square 2000 ml beakers (these are preferable to round beakers due to improved mixing, and the sampling port which makes sampling easier)
- 1 5 gallon bucket about 4/5 full of source water
- A small beaker with ACH coagulant
- Distilled water, both for mixing the coagulant and rinsing out the turbidimeter vials after testing is done
- One container with lid for mixing the 1% coagulant solution
- A turbidity analyzer with vials
- Pipettes/Syringes for dosing neat coagulant into distilled water, as well as a separate pipette or syringe for dosing the 1% solution into the raw water
- A data sheet to record data and observations (sample sheet is at the end of this SOP)
- A program to run the jar tester, so you don't have to manually adjust speeds and set timers during the process. A separate SOP has been developed to walk you through programming the suggested steps (fast mix, slow mix and sedimentation). Once this has been programmed into gang stirrer, the gang stirrer can be set to run the program very easily. The program on the SOP is as follows:
  - 100 RPM for 1 minute (flash mix/coagulation)
  - 35 RPM for 10 minutes (slow mix/flocculation)
  - 0 RPM for 10 minutes (sedimentation)
  - An alarm will sound at the end of the last 10 minutes to indicate it is time to take samples

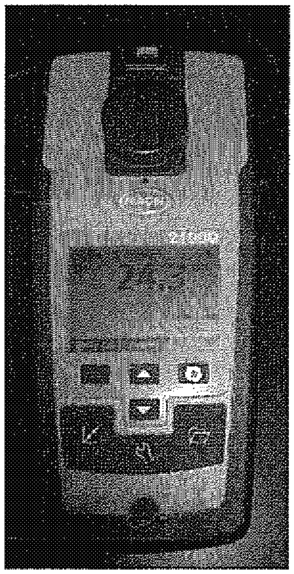

Fig 10. Turbidity analyzer with vial inserted and example NTU reading. This is located in the laboratory.

Jar Testing Steps

1. Set up the lab with all the necessary pieces of equipment and chemicals, including raw water and coagulant.

2. Next, stir up the raw water in the bucket to ensure the sand and other particles are thoroughly mixed in. Take a turbidity sample from the raw water bucket and record it on the data sheet.

3. Now, fill each of the 6 square beakers to the 2000 ml line as close as possible with raw water. You can use a pipette to fine tune it once you're close.

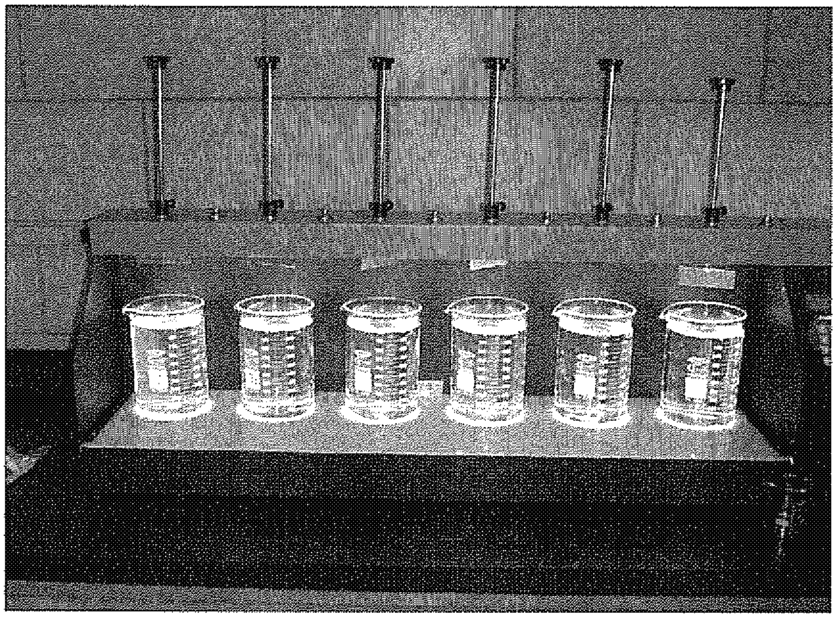

Fig. 11. Beakers with raw water. Round 1000 ml beakers were used here; however, square 2000 ml beakers (not shown) are preferred for jar testing due to improved mixing. The siphon tube is also helpful for sample collection.

4. Decide on how much you want to dose in the different beakers. You want to have a couple doses that are lower than the current feed rate, and a couple doses that are higher. For example, if the chemical feed pump is supplying 15 mg/L, you could try adding a dose of 5 mg/L, 10 mg/L, 15 mg/L, 20 mg/L and 25 mg/L to five different jars. Be sure to leave one jar as a control or blank, meaning you don't add any coagulant to it. Write down the dosages you want to add to each beaker on your data sheet. You can also write them on slips of paper and put them in front of each beaker, so you can keep track of which is which.
   Note: for your first set of jar tests, it may be worthwhile to only use 1 or 2 beakers until you get the hang of it, and then adding others as needed. Having a helper for this process makes a big difference.

5. Next, determine how much 1% ACH solution you need to make. This concentration of coagulant will add 5 mg/L for every 1 ml you add into the raw water beakers (see table below).

Table 1. Dosing the Raw Water Beakers

If you want to have this concentration of ACH (in mg/L)...	Then you should add this much of a 1% coagulant solution (in ml)...	To this much raw water
5	1	2000 ml (square beakers)
10	2	
15	3	
20	4	
25	5	
30	6	

So, to reach a concentration of 10 mg/L ACH in a beaker, you would simply add 2 ml of the 1% coagulant solution. If we continue our example of dosing 5 mg/L, 10 mg/L, 15 mg/L, 20 mg/L and 25 mg/L, we would need a total of 15 ml of 1% ACH (simply add the concentrations in mg/L and divide by 5: (5+10+15+20+25) = 75. 75/5 = 15 ml of 1% coagulant solution). To be safe, we would make 50 ml of the 1% coagulant solution, in case we want to do another jar test. Next, follow the guidelines in the below table to determine how much coagulant you need to add to distilled water to make the 1% coagulant solution:

Table 2. Making the 1% Coagulant Solution

If you want to make this amount of 1% coagulant solution (in ml)...	Then you should add this amount of coagulant (in ml)...	To this amount of distilled water (in ml)
50	**0.37**	**49.5**
100	0.75	99
150	**1.12**	**148.5**
200	1.49	198

Mix the ACH with water in a small container, preferably with a lid. You'll draw from this container when you dose the coagulant into the larger beakers with the raw water. Once this mixture has been made, secure the container with a lid and shake for 30 seconds to a minute.

6. At this point, you can lower the paddles into the raw water beakers, and turn on the gang-stirrer. Press 2 on the keypad to select **RUN SEQUENTIAL**. The jar tester will start rotating at 100

rpm. This will simulate the coagulation step in the static mixer currently in use. Using a pipette, add the desired coagulant dosage to each beaker. In this example, we would dose as follows:

a. Jar 1 – 0 mg/l (control)
b. Jar 2 – 5 mg/l (1 ml of 1% coagulant solution)
c. Jar 3 – 10 mg/l (2 ml of 1% coagulant solution)
d. Jar 4 – 15 mg/l (3 ml of 1% coagulant solution)
e. Jar 5 – 20 mg/l (4 ml of 1% coagulant solution)
f. Jar 6 – 25 mg/l (5 ml of 1% coagulant solution)

Try to add the coagulant as quickly as possible to each jar, so each jar has about the same amount of time for the coagulant to disperse.

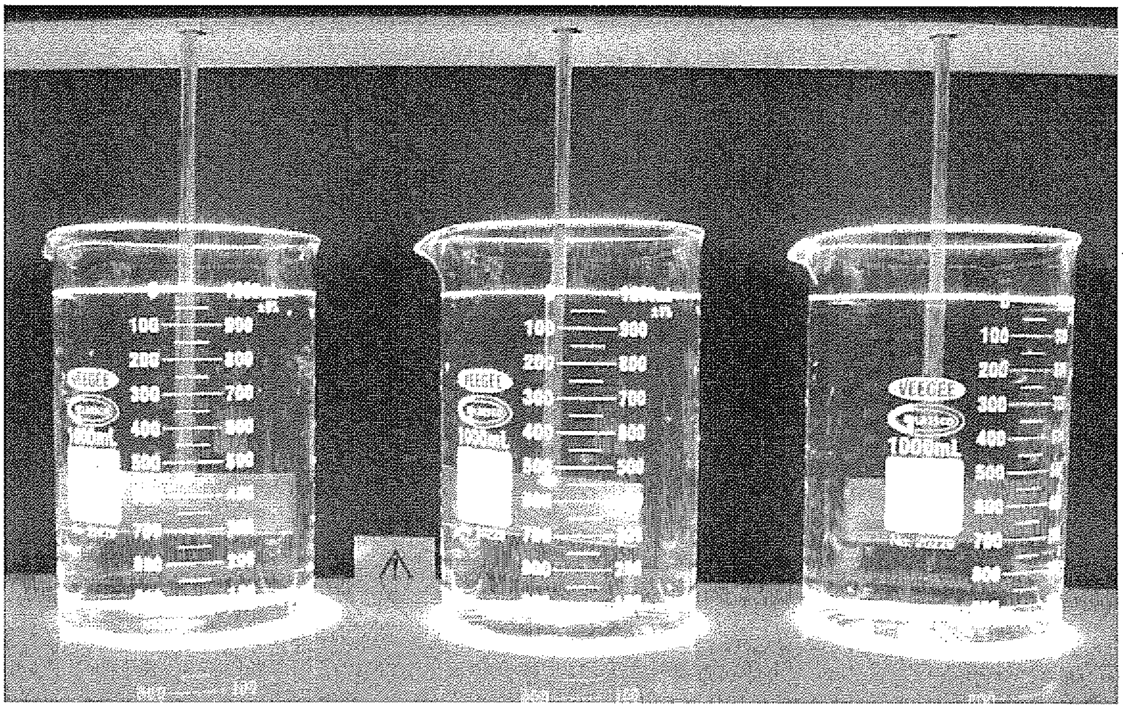

Fig. 12. Initial mixing of jar test

7. After the minute is up, the jar tester will continue to the next step of the program and rotate at 35 rpm for 10 minutes. This will simulate the flocculation step. While the gang stirrer is running, observe each beaker and note which jar forms flocs first, and write this on your data sheet. Also note how the floc particles are forming. Some will be a little larger and fluffy, and others will be more compact. Floc particles which are more compact are more desirable, as they are easier to remove. Note any observations on your data sheet. The background light switch is to the right of the right-most beaker, and is helpful in illuminating flocs.

Fig. 13. Jars during the flocculation stage. Note slips of paper noting the coagulant dosage for each beaker.

8. Once the 10 minutes have passed, the paddles will stop stirring so the particles have a chance to simply settle out, as they would in the sedimentation basin. You can leave the paddles in the beakers. Continue observing and making notes on your data sheet as needed.
9. At the end of the 10 minutes, the alarm should sound, signaling the end of the sedimentation step. Drain the siphon tube for each beaker so you collect a fresh sample. Start collecting turbidity samples from the beakers. Use the tube from each beaker to sample enough water to fill the turbidity vials to the appropriate line. Make sure to collect the samples, check the turbidity and write down the result quickly, so that each jar is sampled right after the other. Leaving too much time between samples will affect the results, as beakers that have not been sampled until much later will have more particles that settle out, giving the appearance that the dosage in that beaker is preferable.
10. Now, analyze your results. Based on the final turbidity of the beakers, which coagulant dosage is best? Based on the floc formation, which coagulant dosage is best? If two dosages give similar results (for instance, 7 mg/l and 10 mg/l both give about the same turbidity readings), it may be worth it to conduct a second round of jar testing. In that case, you could dose the jars as such:
    a. Jar 1 – 0 mg/l (control)
    b. Jar 2 – 7 mg/l

c. Jar 3 – 8 mg/l
d. Jar 4 – 9 mg/l
e. Jar 5 – 10 mg/l
f. Jar 6 – 11 mg/l

Another table with additional concentration dosages is presented here for reference. Any dosage of 1% coagulant solution (in ml) can be determined by dividing the desired concentration of ACH in the raw water (in mg/L) by 5.

Table 3. Additional Dosages for the Raw Water Beakers

If you want to have this concentration of ACH (in mg/L)...	Then you should add this much of a 1% coagulant solution (in ml)...	To this much raw water
6	1.2	2000 ml (square beakers)
7	1.4	
8	1.6	
9	1.8	
10	2	
11	2.2	

11. Select an optimum coagulant dosage and compare with that currently being dosed by the chemical feed pump, as guided by the SCM. If it's a slight difference, adjust the chemical feed pump as necessary. Use the table provided under the SCM section as a guide, taking into consideration whether one raw water pump is running or both. If there is constantly a wide variation between the optimal dosage found through jar testing, and that found by using the SCM, that may point to an issue in the SCM, jar testing methodology, or both. In those cases, reaching out to appropriate IHS personnel may be appropriate.

Programming the Jar Tester

Note: parts of this SOP were modified from the PB-900 Programmable JarTester Instruction Manual, developed by Phipps&Bird.

Jar testing involves testing the effectiveness of a coagulant over different mixing speeds, each for different lengths of time. Running a jar test can involve a lot of tasks, and manually adjusting the timing and mixing speed of the gang stirrer can interrupt the work flow.

This is a guide to program the jar tester so it automatically runs through a sequence of mixing speeds and times with the push of just a couple buttons, and eliminates the need to adjust mixing speeds and set separate timers.

We are going to set up the gang stirrer to run this series of mixes:

100 RPM for 1 minute (flash mix/coagulation)

35 RPM for 10 minutes (slow mix/flocculation)

0 RPM for 10 minutes (sedimentation)

We will program one alarm into this program, at the end of the sedimentation step. If you want to add more alarms in the future, you should have a clear sense of how to do that if desired in the future by the end of this SOP.

1. Turn the power switch to on. The **MAIN** selection window will appear. This will have four options:

    1) Run Continuous
    2) Run Sequential
    3) Run Single Memory
    4) Program Memories

2. Select **PROGRAM MEMORIES** by hitting 4 on the keypad. The **CHOOSE MEMORY** screen will appear:

Choose Memory		M1
RPM:	000	
Time:	00:00	mm:ss
Alarm:	00	minutes

3. Press **ENTER** and **EDITING VALUES IN M1** will appear:

Editing Values in M1		
RPM:	000	
Time:	00:00	mm:ss
Alarm:	00	minutes

4. A blinking cursor will appear besides **RPM**. Hit **100** on the keypad and hit **ENTER** to set the **RPM** setting. The cursor will then move to the next field, **TIME**.

Editing Values in M1		
RPM:	100	
Time:	00:00	mm:ss
Alarm:	00	minutes

5. Press **100** and **ENTER** to accept run time.

Editing Values in M1		
RPM:	100	
Time:	1:00	mm:ss
Alarm:	00	minutes

6. The cursor will move to the **ALARM** field. If the value for **ALARM** is not **0**, hit **0** and **ENTER** to set it. Otherwise, press **BACK** to go to the **CHOOSE MEMORY** screen.
7. Press **UP** and **ENTER**. The **EDITING VALUES IN M2** screen will appear. Press **35** and **ENTER** to change the **RPM** setting.

Editing Values in M2		
RPM:	035	
Time:	00:00	mm:ss
Alarm:	00	minutes

8. The cursor will move to **TIME**. Hit **1000** on the keypad and **ENTER** to set the **TIME**.

Editing Values in M2		
RPM:	035	
Time:	10:00	mm:ss
Alarm:	00	minutes

9. The cursor will move to the **ALARM** field. If the value for **ALARM** is not **0**, hit **0** and **ENTER** to set it. Otherwise, press **BACK** to go to the **CHOOSE MEMORY** screen.
10. Press **UP** twice and **ENTER**. The **EDITING VALUES IN M3** screen will appear.
11. Press **0** and **ENTER** to accept the **RPM** setting.

Editing Values in M3		
RPM:	000	
Time:	00:00	mm:ss
Alarm:	00	minutes

12. Press **1000** and **ENTER** to accept the time.

Editing Values in M3		
RPM:	000	
Time:	10:00	mm:ss
Alarm:	00	minutes

13. Press **10** and **ENTER** to set the **ALARM** frequency.

Editing Values in M3		
RPM:	000	
Time:	10:00	mm:ss
Alarm:	10	minutes

14. Press **BACK** to go to the **CHOOSE MEMORY** screen.
15. Press **DOWN** to go to the **EDITING VALUES IN M4** screen. Ensure all parameters are set to **0**; if not, follow the steps above to set them to **0**.

Editing Values in M4		
RPM:	000	
Time:	00:00	mm:ss
Alarm:	00	minutes

16. Press **BACK** twice to go to the **MAIN** selection window. You have finished programming the jar tester. You can turn off the jar tester and unplug it, and the programmed memories you just assigned will be available whenever it is turned on in the future.

When you are ready to begin (ie, raw water is in each beaker, the paddles have been lowered into the beakers, and coagulant is ready to dose), turn **ON** the jar testing setup. Press **2** to select **RUN SEQUENTIAL**. This will run the program stored in M1 (the fast mix), then the program stored in M2 (the slow mix) and finally the program stored in M3 (sedimentation/no mixing). M4, as it has all its parameters zeroed out, will not contribute to the sequential program.

Once you have experience jar testing and want to change the program to more accurately match conditions in the plant, you can use this as a reference to do so, or you can use the PB-900 Programmable JarTester Instruction Manual, available from the Phipps & Bird website, and attached here for reference.

Jar Testing Data Collection - to be done weekly if SCM is working, or daily if SCM is not working

PWS ID#	104101247
Plant Name	Warm Springs Water Treatment Plant
Operator	
Date	
Time	

Initial Turbidity (NTU)

	Jar 1	Jar 2	Jar 3	Jar 4	Jar 5	Jar 6
ACH Dosage (mg/L)						
Final Turbidity (NTU)						
First to form floc						
Observations (ex, small pinhole floc, large fluffy floc, etc)						

Initial Turbidity (NTU)

	Jar 1	Jar 2	Jar 3	Jar 4	Jar 5	Jar 6
ACH Dosage (mg/L)						
Final Turbidity (NTU)						
First to form floc						
Observations (ex, small pinhole floc, large fluffy floc, etc)						

ED_004384_00006144-00035

SCM Data Reporting - to be done hourly while plant is on

PWS ID# 104101247

Plant Name Warm Springs Water Treatment Plant

				Changed Pump Parameters			
Date	Time	Operator	SCM Reading before adjusting LMI Pump	Stroke	Speed (strokes per minute)	SCM Reading after adjusting LMI Pump	# Raw Water Pumps